

- II. "Summary of a paper (to be presented) entitled Experimental Researches on the Spinal Cord as a leader for Sensibility and Voluntary Movements." By E. BROWN-SÉQUARD, M.D. Communicated by JAMES PAGET, Esq., F.R.S. Received June 25, 1857.

The new field opened by the genius of Sir Charles Bell is enlarging every day, and interesting advances in Physiology and Pathology are constantly being made which are due to the admirable discoveries of this eminent biologist. The following results of my experiments are new developments of these discoveries.

I. It has been well proved by the researches, of which I have already published the results, that the nerve-fibres employed to convey sensitive impressions, may be deprived of sensibility, so that the property of being sensitive and that of conveying sensitive impressions are distinct one from the other. A similar distinction must be made as regards the voluntary motor nerve-fibres. I have found them inexcitable by some of our means of excitation in places where there are a great many of them conveying the orders of the will to muscles. When we introduce a needle gently through the medulla oblongata from behind forwards, traversing successively one of the restiform bodies, the descending root of the trigeminal nerve, some gray matter and the anterior pyramid, not only the animal does not give signs of pain, but there is usually no movement produced in any part of the body. The precautions which must be taken to obtain this result are described in the paper; I will merely say here that if the needle is introduced obliquely instead of perpendicularly, a spasm of the muscles of the neck occurs, and sometimes the animal rotates.

This experiment shows that the irritation of the anterior pyramids with a needle, does not excite more movement than that of the cerebral lobes, although these pyramids are certainly channels for the transmission of orders of the will to muscles. It results from this fact, that the conclusion, drawn by some physiologists, from the inexcitability of the cerebral lobes, that the voluntary motor nerve-fibres do not go into them, is not well-grounded.

I have found that the olivary tract of the medulla oblongata is both sensitive and motor, although it is not, as I have tried to prove elsewhere, a leader for sensibility and voluntary movements.

II. Some experiments which I made two or three years ago, and many that I have recently performed, show that the lateral columns of the spinal cord in the neighbourhood of the medulla oblongata, and a part of the anterior gray matter, are the principal, if not the only channels for voluntary movements in that region. Lower down in the spinal cord (in the dorsal and lumbar regions), the anterior columns and the gray matter seem to have alone the function of conductors for voluntary movements. If a transverse section be made of one of the lateral columns with almost the whole of the anterior horn of gray matter, about an inch behind the medulla oblongata, we find voluntary movements almost completely lost on that side. If a transverse section be made of one of the anterior columns of the spinal cord, an inch behind the medulla oblongata, we find that voluntary movements are not much diminished; and, as in this case, we divide also a part of the gray matter, and frequently a part also of the lateral column, it seems that the anterior column there has but little to do with voluntary movements. Other experiments lead to the same conclusion; I will relate the following alone: the anterior columns of the cord, when arrived at the medulla oblongata, are known to send most of their fibres into the lateral parts of this nervous centre, where they may be divided easily. I have found, after the transverse section of the lateral column of the medulla oblongata, that the voluntary movements are very little diminished, and sometimes hardly at all.

Besides, if we divide longitudinally the medulla oblongata, where the pyramids cross each other, we find that the voluntary movements are completely lost in both sides of the body. There are convulsive and reflex movements, but no spontaneous regular movement, and the animals, when put on their feet, fall on one side or the other.

From these facts and many others, it seems:

1st. That the anterior pyramids of the medulla oblongata contain most of the voluntary motor nerve-fibres.

2nd. That in the cervical region of the spinal cord, the voluntary

motor nerve-fibres are mostly in the lateral columns and the anterior gray cornua.

3rd. That, in the dorsal and lumbar regions of the spinal cord, these nerve-fibres are in the anterior columns and in the gray matter.

III. I have shown elsewhere that the transmission of sensitive impressions continues to take place after a transverse section of either the posterior, the lateral, or the anterior columns of the spinal cord; I have shown, also, that after a section of these three columns on the two sides, leaving the central gray matter and a great part of the posterior and anterior gray horns as little injured as possible, the transmission of sensitive impressions continues to take place, although diminished.

Since the publication of my researches on this subject, I have found that the anterior columns contribute positively, though but very little, to the transmission of sensitive impressions. In frogs, in birds, and also in higher animals, I have found that after a complete transverse section of the whole of the spinal cord, except the anterior columns, there are traces of sensibility in the parts of the body which are behind the section. During half an hour, sometimes much longer, after the operation, there is no appearance of sensibility, but after a time sensibility becomes evident. It is not to be found everywhere behind the section, but it exists in many parts of the skin. I was for a long time doubtful on this subject, because many times, in examining carefully the section of the spinal cord, after this organ had become very hard from having been immersed several days in alcohol, I have seen that a small quantity of gray matter had been left undivided at the bottom of the wound. But in multiplying the experiments, I have ascertained beyond all doubt that when the whole of the gray matter has been divided, with even some fibres of the posterior surface of the anterior columns, traces of sensibility could after a certain time be found.

It has of course been impossible to divide absolutely the whole of the gray matter, without dividing at the same time a greater or smaller number of the anterior columns. In looking at the result of this experiment, and comparing it with that of various others, in some of which very little of the gray matter had been left, while in others the number of the divided fibres of the anterior columns was greater than usual, I have found that in the anterior columns,

only a thin layer of fibres seems to be employed in the transmission of sensitive impressions, this layer forming the surface of these columns which is in contact with the gray matter.

IV. After having ascertained that there are some nerve-fibres in the white anterior columns which are employed in the transmission of sensitive impressions, I have tried to find if these fibres are sensitive or not, that is, able to give pain as the posterior roots of nerves, or unable to give pain, as the gray matter; and have found that they seem to be totally deprived of sensibility.

III. "Summary of a paper (to be presented) on the resemblance between the effects of the section of the Sympathetic Nerve in the Neck and of a transverse section of a lateral half of the Spinal Cord." By E. BROWN-SÉQUARD, M.D. Communicated by JAMES PAGET, Esq., F.R.S. Received June 25, 1857.

I will merely indicate here the principal points of similitude between the effects of these two experiments. Some of the results here mentioned as observed after the section of the sympathetic nerve in the neck, have been discovered by Prof. Bernard; the others have been found by myself. As to the effects of the section of a lateral half of the spinal-cord, I have discovered all of them.

*Section of the cervical sympathetic nerve; its effects on the corresponding side of the face.*

1. Blood-vessels dilated (paralysed).
2. As a consequence, more blood.
3. Elevation of temperature.
4. Sensibility slightly increased.
5. Ditto lasting longer there than on the other side, when the animal is chloroformized.
6. Sensibility lasting longer there than on the other side during agony.
7. Many muscles contracted.

*Section of a lateral half of the spinal cord in the dorsal region; its effects on the posterior limb, on the corresponding side.*

1. The same effect.
2. Ditto, ditto.
3. Ditto, ditto.
4. Very much increased.
5. Lasting longer than anywhere else during chloroformization.
6. Lasting longer than anywhere else during agony.
7. A state of slight contraction in many muscles.